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ET is defined in 5.2.1, and

Number 1 indicates the test period during which the highest compartment temperature is measured.

6.2.1.2 If one of the compartment temperatures measured for a test period is greater than 0.0 °F. (17.8 °C.), the average per-cycle energy consumption shall be equivalent to:

$$E = ET1 + ((ET2 - ET1) \times (0.0 - TF1) / (TF2 - TF1))$$

where

E is defined in 6.2.1.1

ET is defined in 5.2.1

TF=compartment temperature determined according to 5.1.2 in degrees F.

Numbers 1 and 2 indicate measurements taken during the first and second test period as appropriate, and

0.0=Standardized compartment temperature in degrees F.

[47 FR 34528, Aug. 10, 1982; 48 FR 13013, Mar. 29, 1983, as amended at 54 FR 36241, Aug. 31, 1989; 54 FR 38788, Sept. 20, 1989]

APPENDIX C TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF DISHWASHERS

The provisions of this Appendix C shall apply to products manufactured after September 29, 2003. The restriction on representations concerning energy use or efficiency in 42 U.S.C. 6293(c)(2) shall apply on February 25, 2004.

1. Definitions

1.1 *AHAM* means the Association of Home Appliance Manufacturers.

1.2 *Compact dishwasher* means a dishwasher that has a capacity of less than eight place settings plus six serving pieces as specified in ANSI/AHAM DW-1 (see § 430.22), using the test load specified in section 2.7 of this Appendix.

1.3 *Cycle* means a sequence of operations of a dishwasher which performs a complete dishwashing function, and may include variations or combinations of washing, rinsing, and drying.

1.4 *Cycle type* means any complete sequence of operations capable of being preset on the dishwasher prior to the initiation of machine operation.

1.5 *Non-soil-sensing dishwasher* means a dishwasher that does not have the ability to adjust automatically any energy consuming aspect of a wash cycle based on the soil load of the dishes.

1.6 *Normal cycle* means the cycle type recommended by the manufacturer for completely washing a full load of normally soiled dishes including the power-dry feature.

1.7 *Power-dry feature* means the introduction of electrically generated heat into the washing chamber for the purpose of improv-

ing the drying performance of the dishwasher.

1.8 *Preconditioning cycle* means any cycle that includes a fill, circulation, and drain to ensure that the water lines and sump area of the pump are primed.

1.9 *Sensor heavy response* means, for standard dishwashers, the set of operations in a soil-sensing dishwasher for completely washing a load of dishes, four place settings of which are soiled according to ANSI/AHAM DW-1 (Incorporated by reference, see § 430.22). For compact dishwashers, this definition is the same, except that two soiled place settings are used instead of four.

1.10 *Sensor light response* means, for both standard and compact dishwashers, the set of operations in a soil-sensing dishwasher for completely washing a load of dishes, one place setting of which is soiled with half of the gram weight of soils for each item specified in a single place setting according to ANSI/AHAM DW-1 (Incorporated by reference, see § 430.22).

1.11 *Sensor medium response* means, for standard dishwashers, the set of operations in a soil-sensing dishwasher for completely washing a load of dishes, two place settings of which are soiled according to ANSI/AHAM DW-1 (Incorporated by reference, see § 430.22). For compact dishwashers, this definition is the same, except that one soiled place setting is used instead of two.

1.12 *Soil-sensing dishwasher* means a dishwasher that has the ability to adjust any energy consuming aspect of a wash cycle based on the soil load of the dishes.

1.13 *Standard dishwasher* means a dishwasher that has a capacity equal to or greater than eight place settings plus six serving pieces as specified in ANSI/AHAM DW-1 (Incorporated by reference, see § 430.22), using the test load specified in section 2.7 of this Appendix.

1.14 *Standby mode* means the lowest power consumption mode which cannot be switched off or influenced by the user and that may persist for an indefinite time when the dishwasher is connected to the main electricity supply and used in accordance with the manufacturer's instructions.

1.15 *Truncated normal cycle* means the normal cycle interrupted to eliminate the power-dry feature after the termination of the last rinse operation.

1.16 *Truncated sensor heavy response* means the sensor heavy response interrupted to eliminate the power-dry feature after the termination of the last rinse operation.

1.17 *Truncated sensor light response* means the sensor light response interrupted to eliminate the power-dry feature after the termination of the last rinse operation.

1.18 *Truncated sensor medium response* means the sensor medium response interrupted to eliminate the power-dry feature

after the termination of the last rinse operation.

1.19 *Water-heating dishwasher* means a dishwasher which, as recommended by the manufacturer, is designed for heating cold inlet water (nominal 50 °F) or designed for heating water with a nominal inlet temperature of 120 °F. Any dishwasher designated as water-heating (50 °F or 120 °F inlet water) must provide internal water heating to above 120 °F in at least one wash phase of the normal cycle.

2. Testing conditions:

2.1 *Installation Requirements.* Install the dishwasher according to the manufacturer's instructions. A standard or compact under-counter or under-sink dishwasher must be tested in a rectangular enclosure constructed of nominal 0.374 inch (9.5 mm) plywood painted black. The enclosure must consist of a top, a bottom, a back, and two sides. If the dishwasher includes a counter top as part of the appliance, omit the top of the enclosure. Bring the enclosure into the closest contact with the appliance that the configuration of the dishwasher will allow.

2.2 Electrical energy supply.

2.2.1 *Dishwashers that operate with an electrical supply of 115 volts.* Maintain the electrical supply to the dishwasher at 115 volts ± 2 percent and within 1 percent of the nameplate frequency as specified by the manufacturer.

2.2.2 *Dishwashers that operate with an electrical supply of 240 volts.* Maintain the electrical supply to the dishwasher at 240 volts ± 2 percent and within 1 percent of its nameplate frequency as specified by the manufacturer.

2.3 *Water temperature.* Measure the temperature of the water supplied to the dishwasher using a temperature measuring device as specified in section 3.1 of this Appendix.

2.3.1 *Dishwashers to be tested at a nominal 140 °F inlet water temperature.* Maintain the water supply temperature at $140^{\circ} \pm 2^{\circ} \text{F}$.

2.3.2 *Dishwashers to be tested at a nominal 120 °F inlet water temperature.* Maintain the water supply temperature at $120^{\circ} \pm 2^{\circ} \text{F}$.

2.3.3 *Dishwashers to be tested at a nominal 50 °F inlet water temperature.* Maintain the water supply temperature at $50^{\circ} \pm 2^{\circ} \text{F}$.

2.4 *Water pressure.* Using a water pressure gauge as specified in section 3.4 of this Appendix, maintain the pressure of the water supply at 35 ± 2.5 pounds per square inch gauge (psig) when the water is flowing.

2.5 *Ambient and machine temperature.* Using a temperature measuring device as specified in section 3.1 of this Appendix, maintain the room ambient air temperature at $75^{\circ} \pm 5^{\circ} \text{F}$, and ensure that the dishwasher and the test load are at room ambient temperature at the start of each test cycle.

2.6 Test Cycle and Load.

2.6.1 *Non-soil-sensing dishwashers to be tested at a nominal inlet temperature of 140 °F.* These units must be tested on the normal cycle and truncated normal cycle without a test load if the dishwasher does not heat water in the normal cycle.

2.6.2 *Non-soil-sensing dishwashers to be tested at a nominal inlet temperature of 50 °F or 120 °F.* These units must be tested on the normal cycle with a clean load of eight place settings plus six serving pieces, as specified in section 2.7 of this Appendix. If the capacity of the dishwasher, as stated by the manufacturer, is less than eight place settings, then the test load must be the stated capacity.

2.6.3 *Soil-sensing dishwashers to be tested at a nominal inlet temperature of 50 °F, 120 °F, or 140 °F.* These units must be tested first for the sensor heavy response, then tested for the sensor medium response, and finally for the sensor light response with the following combinations of soiled and clean test loads.

2.6.3.1 For tests of the sensor heavy response, as defined in section 1.9 of this Appendix:

(A) For standard dishwashers, the test unit is to be loaded with a total of eight place settings plus six serving pieces as specified in section 2.7 of this Appendix. Four of the eight place settings must be soiled according to ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22) while the remaining place settings, serving pieces, and all flatware are not soiled.

(B) For compact dishwashers, the test unit is to be loaded with four place settings plus six serving pieces as specified in section 2.7 of this Appendix. Two of the four place settings must be soiled according to ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22) while the remaining place settings, serving pieces, and all flatware are not soiled.

2.6.3.2 For tests of the sensor medium response, as defined in section 1.11 of this Appendix:

(A) For standard dishwashers, the test unit is to be loaded with a total of eight place settings plus six serving pieces as specified in section 2.7 of this Appendix. Two of the eight place settings must be soiled according to ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22) while the remaining place settings, serving pieces, and all flatware are not soiled.

(B) For compact dishwashers, the test unit is to be loaded with four place settings plus six serving pieces as specified in section 2.7 of this Appendix. One of the four place settings must be soiled according to ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22) while the remaining place settings, serving pieces and all flatware are not soiled.

2.6.3.3 For tests of the sensor light response, as defined in section 1.10 of this Appendix:

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(A) For standard dishwashers, the test unit is to be loaded with a total of eight place settings plus six serving pieces as specified in section 2.7 of this Appendix. One of the eight place settings must be soiled with half of the soil load specified for a single place setting according to ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22) while the remaining place settings, serving pieces, and all flatware are not soiled.

(B) For compact dishwashers, the test unit is to be loaded with four place settings plus six serving pieces as specified in section 2.7 of this Appendix. One of the four place settings must be soiled with half of the soil load specified for a single place setting according to the ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22) while the remaining place settings, serving pieces, and all flatware are not soiled.

2.7 Test Load.

| Dishware/glassware/flatware item | Primary source | Description | Primary No. | Alternate source | Alternate source No. |
|----------------------------------|--------------------------|-----------------------------|-------------|------------------|----------------------|
| Dinner Plate | Corning Comcor®/Corelle® | 10 inch Dinner Plate | 6003893 | | |
| Bread and Butter Plate | Corning Comcor®/Corelle® | 6.75 inch Bread & Butter | 6003887 | Arzberg ... | 8500217100 |
| Fruit Bowl | Corning Comcor®/Corelle® | 10 oz. Dessert Bowl | 6003899 | Arzberg ... | 3820513100 |
| Cup | Corning Comcor®/Corelle® | 8 oz. Ceramic Cup | 6014162 | Arzberg ... | 3824732100 |
| Saucer | Corning Comcor®/Corelle® | 6 inch Saucer | 6010972 | Arzberg ... | 3824731100 |
| Serving Bowl | Corning Comcor®/Corelle® | 1 qt. Serving Bowl | 6003911 | | |
| Platter | Corning Comcor®/Corelle® | 9.5 inch Oval Platter | 6011655 | | |
| Glass-Iced Tea | Libbey | 551 HT | 551 HT | | |
| Flatware—Knife | Oneida®—Accent | 2619KPVF | 2619KPVF | | |
| Flatware—Dinner Fork | Oneida®—Accent | 2619FRSF | 2619FRSF | | |
| Flatware—Salad Fork | Oneida®—Accent | 2619FSLF | 2619FSLF | | |
| Flatware—Teaspoon | Oneida®—Accent | 2619STSF | 2619STSF | | |
| Flatware—Serving Fork | Oneida®—Flight | 2865FCM | 2865FCM | | |
| Flatware—Serving Spoon .. | Oneida®—Accent | 2619STBF | 2619STBF | | |

2.8 *Detergent.* Use half the quantity of detergent specified according to ANSI/AHAM DW-1 (Incorporated by reference, *see* §430.22).

2.9 *Testing requirements.* Provisions in this Appendix pertaining to dishwashers that operate with a nominal inlet temperature of 50 °F or 120 °F apply only to water-heating dishwashers as defined in section 1.19 of this Appendix.

2.10 *Preconditioning requirements.* Precondition the dishwasher by establishing the testing conditions set forth in sections 2.1 through 2.5 of this Appendix. Set the dishwasher to the preconditioning cycle as defined in section 1.8 of this Appendix, without using a test load, and initiate the cycle.

3. Instrumentation

Test instruments must be calibrated annually.

3.1 *Temperature measuring device.* The device must have an error no greater than ± 1 °F over the range being measured.

3.2 *Timer.* Time measurements for each monitoring period shall be accurate to within 2 seconds.

3.3 *Water meter.* The water meter must have a resolution of no larger than 0.1 gallons and a maximum error no greater than ± 1.5 percent of the measured flow rate for all water temperatures encountered in the test cycle.

3.4 *Water pressure gauge.* The water pressure gauge must have a resolution of one pound per square inch (psi) and must have an error no greater than 5 percent of any measured value over the range of 35 ± 2.5 psig.

3.5 *Watt-hour meter.* The watt-hour meter must have a resolution of 1 watt-hour or less and a maximum error of no more than 1 percent of the measured value for any demand greater than 50 watts.

3.6 *Standby wattmeter.* The standby wattmeter must have a resolution of 0.1 watt or less, a maximum error of no more than 1 percent of the measured value, and must be capable of operating within the stated tolerances for input voltages up to 5 percent total harmonic distortion. The standby wattmeter must be capable of operating at frequencies from 47 hertz through 63 hertz. Power measurements must have a crest factor of 3 or more at currents of 2 amps RMS or less.

3.7 *Standby watt-hour meter.* The standby watt-hour meter must meet all the requirements of the standby wattmeter and must accumulate watt-hours at a minimum power level of 20 milliwatts.

4. Test Cycle and Measurements

4.1 *Test cycle.* Perform a test cycle by establishing the testing conditions set forth in section 2 of this Appendix, setting the dishwasher to the cycle type to be tested, initiating the cycle, and allowing the cycle to proceed to completion.

4.2 *Machine electrical energy consumption.* Measure the machine electrical energy consumption, M, expressed as the number of kilowatt-hours of electricity consumed by the machine during the entire test cycle, using a water supply temperature as set forth in section 2.3 of this Appendix and using a watt-

hour meter as specified in section 3.5 of this Appendix.

4.3 *Water consumption.* Measure the water consumption, V, expressed as the number of gallons of water delivered to the machine during the entire test cycle, using a water meter as specified in section 3.3 of this Appendix.

4.4 *Standby power.* Connect the dishwasher to a standby wattmeter or a standby watt-hour meter as specified in sections 3.6 and 3.7, respectively, of this Appendix. Select the conditions necessary to achieve operation in the standby mode as defined in section 1.14 of this Appendix. Monitor the power consumption but allow the dishwasher to stabilize for at least 5 minutes. Then monitor the power consumption for at least an additional 5 minutes. If the power level does not change by more than 5 percent from the maximum observed value during the later 5 minutes and there is no cyclic or pulsing behavior of the load, the load can be considered stable. For stable operation, standby power, S_m , can be recorded directly from the standby watt meter in watts or accumulated using the standby watt-hour meter over a period of at least 5 minutes. For unstable operation, the energy must be accumulated using the standby watt-hour meter over a period of at least 5 minutes and must capture the energy use over one or more complete cycles. Calculate the average standby power, S_m , expressed in watts by dividing the accumulated energy consumption by the duration of the measurement period.

5. Calculation of Derived Results From Test Measurements

5.1 Machine energy consumption.

5.1.1 *Machine energy consumption for non-soil-sensing electric dishwashers.* Take the value recorded in section 4.2 of this Appendix as the per-cycle machine electrical energy consumption. Express the value, M, in kilowatt-hours per cycle.

5.1.2 *Machine energy consumption for soil-sensing electric dishwashers.* The machine energy consumption for the sensor normal cycle, M, is defined as:

$$M = (M_{hr} \times F_{hr}) + (M_{mr} \times F_{mr}) + (M_{lr} \times F_{lr})$$

where,

M_{hr} = the value recorded in section 4.2 of this Appendix for the test of the sensor heavy response, expressed in kilowatt-hours per cycle,

M_{mr} = the value recorded in section 4.2 of this Appendix for the test of the sensor medium response, expressed in kilowatt-hours per cycle,

M_{lr} = the value recorded in section 4.2 of this Appendix for the test of the sensor light response, expressed in kilowatt-hours per cycle,

F_{hr} = the weighting factor based on consumer use of heavy response = 0.05,

F_{mr} = the weighting factor based on consumer use of medium response = 0.33,

F_{lr} = the weighting factor based on consumer use of light response = 0.62.

5.2 Drying energy.

5.2.1 *Drying energy consumption for non-soil-sensing electric dishwashers.* Calculate the amount of energy consumed using the power-dry feature after the termination of the last rinse option of the normal cycle. Express the value, E_D , in kilowatt-hours per cycle.

5.2.2 *Drying energy consumption for soil-sensing electric dishwashers.* The drying energy consumption, E_D , for the sensor normal cycle is defined as:

$$E_D = (E_{Dhr} + E_{Dmr} + E_{Dlr})/3$$

Where,

E_{Dhr} = energy consumed using the power-dry feature after the termination of the last rinse option of the sensor heavy response, expressed in kilowatt-hours per cycle,

E_{Dmr} = energy consumed using the power-dry feature after the termination of the last rinse option of the sensor medium response, expressed in kilowatt-hours per cycle,

E_{Dlr} = energy consumed using the power-dry feature after the termination of the last rinse option of the sensor light response, expressed in kilowatt-hours per cycle.

5.3 Water consumption.

5.3.1 *Water consumption for non-soil-sensing dishwashers using electrically heated, gas-heated, or oil-heated water.*

Take the value recorded in section 4.3 of this Appendix as the per-cycle water energy consumption. Express the value, V, in gallons per cycle.

5.3.2 *Water consumption for soil-sensing dishwashers using electrically heated, gas-heated, or oil-heated water.*

The water consumption for the sensor normal cycle, V, is defined as:

$$V = (V_{hr} \times F_{hr}) + (V_{mr} \times F_{mr}) + (V_{lr} \times F_{lr})$$

Where,

V_{hr} = the value recorded in section 4.3 of this Appendix for the test of the sensor heavy response, expressed in gallons per cycle,

V_{mr} = the value recorded in section 4.3 of this Appendix for the test of the sensor medium response, expressed in gallons per cycle,

V_{lr} = the value recorded in section 4.3 of this Appendix for the test of the sensor light response, expressed in gallons per cycle,

F_{hr} = the weighting factor based on consumer use of heavy response = 0.05,

F_{mr} = the weighting factor based on consumer use of medium response = 0.33,

F_{lr} = the weighting factor based on consumer use of light response = 0.62.

5.4 *Water energy consumption for non-soil-sensing or soil-sensing dishwashers using electrically heated water.*

5.4.1 *Dishwashers that operate with a nominal 140 °F inlet water temperature, only.* For

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the normal and truncated normal test cycle, calculate the water energy consumption, W , expressed in kilowatt-hours per cycle and defined as:

$$W = V \times T \times K$$

Where,

V = water consumption in gallons per cycle, as determined in section 5.3.1 of this Appendix,

T = nominal water heater temperature rise = 90 °F,

K = specific heat of water in kilowatt-hours per gallon per degree Fahrenheit = 0.0024.

5.4.2 *Dishwashers that operate with a nominal inlet water temperature of 120 °F.* For the normal and truncated normal test cycle, calculate the water energy consumption, W , expressed in kilowatt-hours per cycle and defined as:

$$W = V \times T \times K$$

Where,

V = water consumption in gallons per cycle, as determined in section 5.3.1 of this Appendix,

T = nominal water heater temperature rise = 70 °F,

K = specific heat of water in kilowatt-hours per gallon per degree Fahrenheit = 0.0024.

5.5 *Water energy consumption per cycle using gas-heated or oil-heated water.*

5.5.1 *Dishwashers that operate with a nominal 140 °F inlet water temperature, only.*

For each test cycle, calculate the water energy consumption using gas-heated or oil-heated water, W_g , expressed in Btu's per cycle and defined as:

$$W_g = V \times T \times C/e$$

Where,

V = reported water consumption in gallons per cycle, as determined in section 5.3.2 of this Appendix,

T = nominal water heater temperature rise = 90 °F,

C = specific heat of water in Btu's per gallon per degree Fahrenheit = 8.2,

e = nominal gas or oil water heater recovery efficiency = 0.75.

5.5.2 *Dishwashers that operate with a nominal inlet water temperature of 120 °F.* For each test cycle, calculate the water energy consumption using gas heated or oil heated water, W_g , expressed in Btu's per cycle and defined as:

$$W_g = V \times T \times C/e$$

Where,

V = reported water consumption in gallons per cycle, as determined in section 5.3.2 of this Appendix,

T = nominal water heater temperature rise = 70 °F,

C = specific heat of water in Btu's per gallon per degree Fahrenheit = 8.2,

e = nominal gas or oil water heater recovery efficiency = 0.75.

5.6 *Annual standby energy consumption.* Calculate the estimated annual standby energy consumption. First determine the number of standby hours per year, H_s , defined as:

$$H_s = H - (N \times L).$$

Where,

H = the total number of hours per year = 8766 hours per year,

N = the representative average dishwasher use of 215 cycles per year,

L = the average of the duration of the normal cycle and truncated normal cycle, for non-soil-sensing dishwashers with a truncated normal cycle; the duration of the normal cycle, for non-soil-sensing dishwashers without a truncated normal cycle; the average duration of the sensor light response, truncated sensor light response, sensor medium response, truncated sensor medium response, sensor heavy response, and truncated sensor heavy response, for soil-sensing dishwashers with a truncated cycle option; the average duration of the sensor light response, sensor medium response, and sensor heavy response, for soil-sensing dishwashers without a truncated cycle option.

Then calculate the estimated annual standby power use, S , expressed in kilowatt-hours per year and defined as:

$$S = S_m \times (H_s / 1000)$$

Where,

S_m = the average standby power in watts as determined in section 4.4 of this Appendix.

[68 FR 51900, Aug. 29, 2003]

APPENDIX D TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF CLOTHES DRYERS

1. Definitions

1.1 "AHAM" means the Association of Home Appliance Manufacturers.

1.2 "Bone dry" means a condition of a load of test clothes which has been dried in a dryer at maximum temperature for a minimum of 10 minutes, removed and weighed before cool down, and then dried again for 10-minute periods until the final weight change of the load is 1 percent or less.

1.3 "Compact" or compact size" means a clothes dryer with a drum capacity of less than 4.4 cubic feet.

1.4 "Cool down" means that portion of the clothes drying cycle when the added gas or electric heat is terminated and the clothes continue to tumble and dry within the drum.

1.5 "Cycle" means a sequence of operation of a clothes dryer which performs a clothes drying operation, and may include variations or combinations of the functions of heating, tumbling and drying.